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Remodeling Corn Cribs for Small Grain Storage

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AED AGRICULTURAL ENGINEERS' DIGEST

REMODELING CORN CRIBS FOR SMALL GRAIN STORAGE*

INTRODUCTION

An ear-corn crib can be economically remodeled for shelled corn storage if it is sturdily built and in good condition. With a few alterations, the crib can be converted into a bin that provides adequate storage and protection.

Reasons for Remodeling

1. Ear-corn cribs usually cannot contain shelled corn. The corn will pass through the openings needed for air movement through ear corn.
2. The structural parts of the crib will not support the added weight and pressure of shelled corn. Shelled corn weighs two thirds more and exerts three and one-half times the pressure of ear corn.
3. Remodeling will usually cost less than the construction of a new storage.

What Must Be Remodeled?

The parts of an ear-corn crib that will usually need altering include:

1. The walls and floors need strengthening.
2. The walls and floors need to be covered with screening or siding that will contain and in some cases protect the shelled corn.

Should You Remodel?

YES, if 1. The needed additional strength can be obtained by making reasonably simple, low-cost alterations.

2. The cost of remodeling is less than one-half the cost of a new structure. A higher cost is sometimes justified where there are already facilities such as an inside elevator, overhead bins, etc.

3. The crib is conveniently located for:
   - Expansion of it and/or related facilities.
   - Integration into a feed processing and handling center.
   - Provision for large electrical loads.
   - Installation of below-grade equipment without flooding (example—elevator pit).

NO, if 1. The crib must be moved to another location on the farm in addition to being remodeled.

2. Major structural changes are required. These include new foundations, a new floor, or extensive replacement or addition of studs, poles, or other framing members.

3. The cost of the remodeling will be more than one-half the cost of a new structure.

4. The remodeled crib cannot maintain the desired grain quality or cannot be easily maintained.

REMODELING PROCEDURE

There are three basic steps in remodeling almost any type of ear-corn crib:

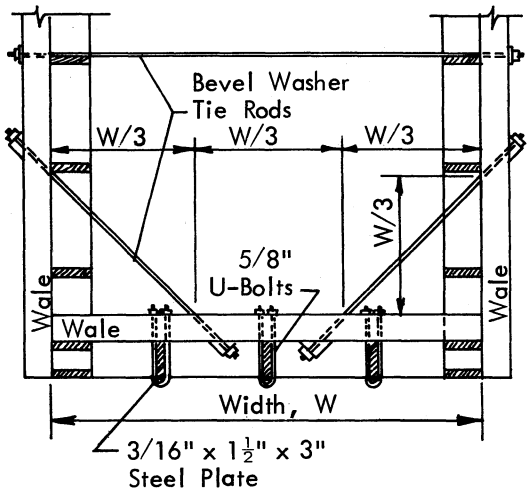
1. Strengthen the structure.
2. Make the walls grain-tight (also weather-tight if long storage periods are desired).
3. Provide for moving the shelled corn into and out of storage.

STRENGTHENING STUD—FRAME CRIBS

Walls

One practical way to strengthen stud walls is to install wales (horizontal stay timbers) and tie rods. The number and size of wales and tie rods needed depends on the stud height, size, and spacing. See Table 1, page 2

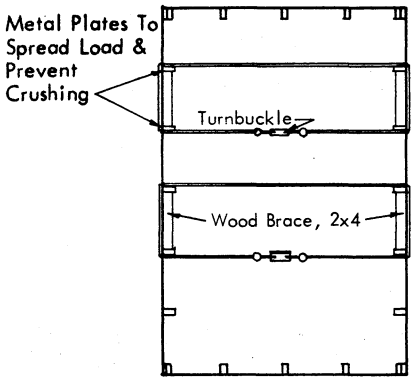
On an End Wall, the wale is run on the inside of the cribbing so that it will not interfere when there are sliding doors on the driveway. Diagonal tie rods are used at the corners to connect the wale with those on the adjacent side walls. Wales and tie rods should be the same size as those on the side walls.



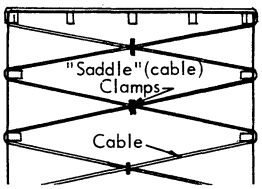
* This publication is a revision of University of Illinois Circular 775 based on work by Dr. J. O. Curtis, Agr. Engr. Dept., University of Illinois.

SIDEWALL REINFORCEMENT

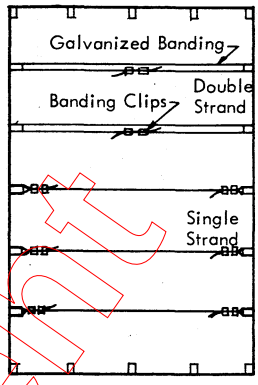
Another practical way to strengthen stud walls is to install steel bands or cables across the crib. Several recommended ways of installing these ties are shown in the following drawings. The number and size of cable or banding to install is listed in Table 1. Note that no wales are used.



Cable - Turnbuckle Method
Tighten the cables with turnbuckles or some other method such as a fence tightener.

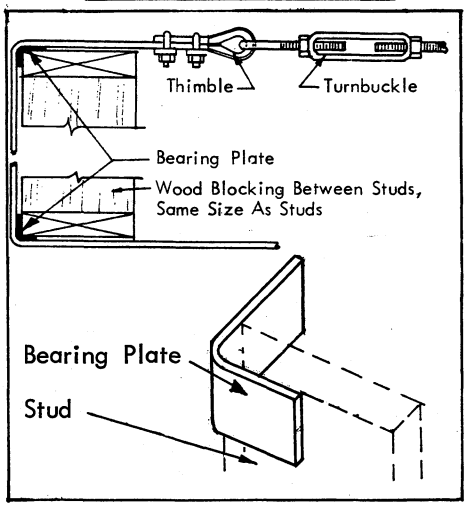


Cable "Shoelace" Method

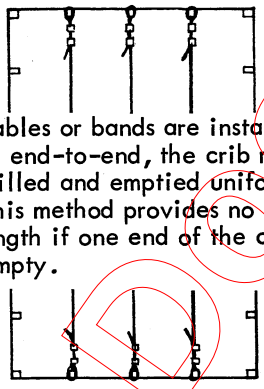


Steel Banding Method
Install double clips on all bands. Avoid damaging the galvanizing.

BEARING PLATE DETAILS

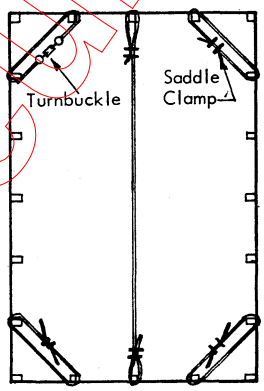


END WALL REINFORCEMENT

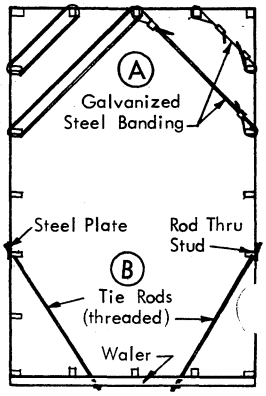


If cables or bands are installed from end-to-end, the crib must be filled and emptied uniformly as this method provides no strength if one end of the crib is empty.

Steel Banding Method



Turnbuckle or Clamp & Cable Method



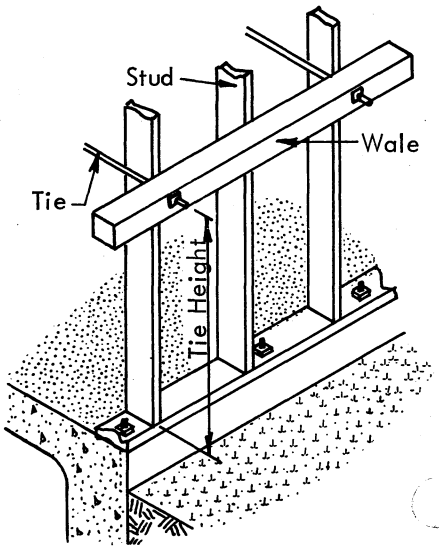
(A) Steel Banding
(B) Tie Rod - Waler

Table 1. Recommended size, spacing, and location of structural members — stud frame cribs

	Stud Height	12'	14'	16'	18'	20
	Stud Size	2 x 6 24" o.c.	2 x 6 18" o.c. or 2 x 8 24" o.c.	2 x 6 12" o.c. or 2 x 8 24" o.c.	2 x 8 18" o.c. or 2 x 10 24" o.c.	2 x 8 12" o.c. or 2 x 10 18" o.c.
Wales and Rods	Tie Heights	6½'	6½'	6½'	7'	7'
	Tie Spacing	4'	4'	4'	4'	3½'
	Threaded Rod Size	⅝"	¾"	⅞"	⅞"	1"
	Unthreaded Rod Size	⅝"	⅝"	¾"	⅞"	⅞"
	Wale Size	4 x 6	4 x 6	4 x 6	6 x 6	6 x 6
Bands or Cables	Install bands or cables 24" o.c.					
	Number of Bands*	1	1	2	2	2
	Cable Size#	⅜"	7/16"	½"	½"	9/16"

* 1¼" x 0.044" high tensile steel strapping, galvanized.

6 x 7 regular lay mild plow steel cable.

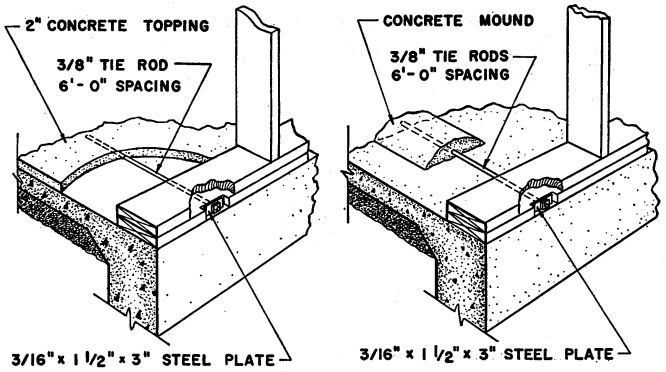


The connections at the top and bottom of studs usually need strengthening also. The sills must be firmly anchored to the foundation wall, with the anchor bolts spaced as followed:

Anchor Size	Concrete Floor With Single Sill	Concrete Floor With Double Sill	Wooden Floor
½ in bolt	2 feet o.c.	2½ feet o.c.	6 feet o.c.
⅝ in bolt	2½ feet o.c.	3½ feet o.c.	6 feet o.c.

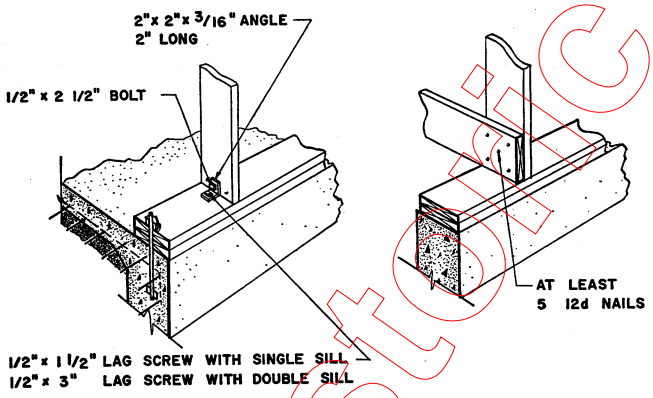
If the present anchor bolts are inadequate, tie rods may be installed as shown below.

If metal stud sockets were used in constructing the crib, the connection at the base of the studs is probably adequate without change.



For easier emptying, cover the rod with a new layer of concrete (left) or a small mound of concrete (right). To secure a bond between the old floor and the new concrete, wash the floor thoroughly and leave it damp.

The bottom ends of studs must be securely fastened to the sill. Use four ten penny nails for 2x6 studs, six for 2x8 studs, and eight for 2x10 studs, or use anchors as shown below.



The top ends of the studs should be tied together with ties as outlined below:

Table 2. Tying studs at the top

Stud height (feet)	Stud size	Stud spacing (inches)	Tie size	Tie spacing (feet)	Nails at each end of tie
12	2 x 6	24	2 x 4	4	4 12d
14	2 x 6	18	2 x 4	4½	5 12d
14	2 x 8	24	2 x 4	4	5 12d
16	2 x 6	12	2 x 4	4	6 12d
16	2 x 8	24	2 x 4	4	6 12d
18	2 x 8	18	2 x 6	4½	8 12d
18	2 x 10	24	2 x 6	4	8 12d
20	2 x 8	12	2 x 6	3	8 12d
20	2 x 10	18	2 x 6	3	8 12d

Foundations and Floors

If the crib has concrete foundation walls at least eight inches thick and a concrete floor in good condition resting on firm subgrades, it will be able to resist the additional load of shelled corn.

The floor for cribs with wooden joists resting on concrete foundation walls will need strengthening. The size of joists needed are listed in Table 3.

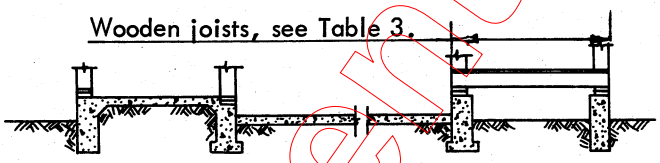
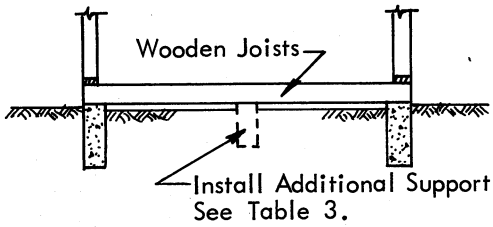


Table 3. Size of joists needed for joists spaced 12 inches on center

Height of Crib	Span 4	6	8	10
8	2 x 6	2 x 8	2 x 10	2 x 12
10	2 x 6	2 x 10	2 x 12	*
12	2 x 6	2 x 10	2 x 12	*
14	2 x 8	2 x 10	*	*
16	2 x 8	2 x 12	*	*
18	2 x 10	2 x 12	*	*

* Install a center support to reduce the span, thereby reducing the size of joist needed. This will normally require removing some of the floor.



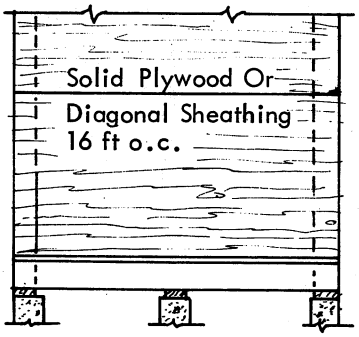
The size of foundation needed depends on the quantity of corn to be stored and the type of soil under the foundation. Foundations should extend 30 inches into the ground. If the foundation supports all of the weight of the corn, as with a wooden floor, the foundation should have one square foot of bearing surface for each 70 bushels of stored corn. A greater load would bear too heavily on the soil. If the size of footing cannot be estimated, the area of the foundation-wall surface can be considered approximately equal to the area bearing on the soil.

Wind Bracing

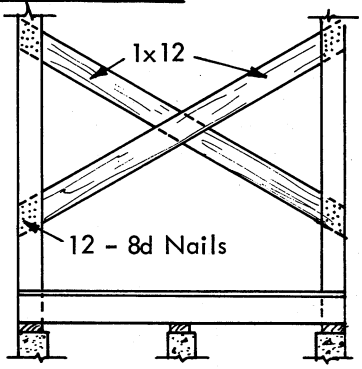
Braces for resistance to wind should be installed each four feet in cribs with overhead bins and each eight feet in cribs without overhead bins.

If cross bracing is not already in place, install solid partitions in the crib about 16 feet apart. Use plywood or diagonal sheathing.

Recommended Bracing



Optional Bracing, 4 to 8 feet o.c.

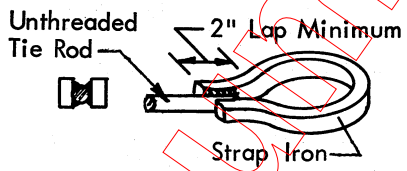


STRENGTHENING POLE CRIBS

Most pole cribs will need sidewall strengthening. Install either threaded or unthreaded tie rods as listed in Table 5. Connect unthreaded tie rods using strap iron as specified in Table 4. Connect threaded tie rods with turnbuckles or other methods of tightening.

Table 4. Size of strap iron needed for unthreaded tie rods

Tie Rod	Size at Strap-Iron
1/2"	1/8" x 1"
5/8"	3/16" x 1"
3/4"	3/16" x 1 1/4"
7/8"	1/4" x 1 1/4"
1"	1/4" x 1 1/2"



When welding the joint, use an AWSE 6010 or AWSE 6011 electrode. Make 4 welds; CAUTION: Do not have a crater in the rod at the end of each bead.

Tie At Top of Poles

In most cases the existing ties at the top of the poles will be satisfactory. A 2x4 or 2x6 cross-tie at each pole should be adequate if it is well spiked to the poles with large pole-barn nails. Sometimes four strands of number nine wire are used as a cross-tie.

Floors and foundations - see page 3.

Wind bracing - see pages 3 and 4.

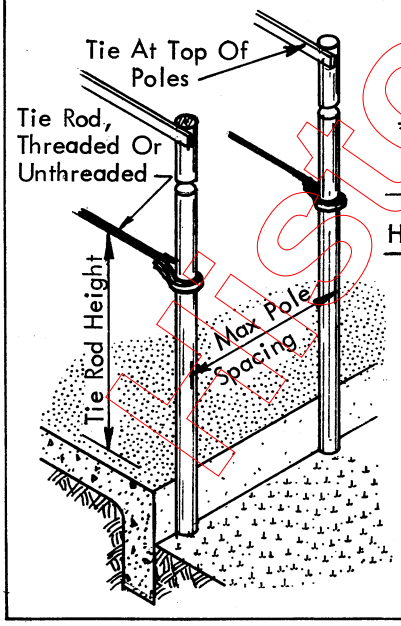


Table 5. Recommended size, spacing, and location of structural members—Pole Cribs

Height	Tie Rod Height	Maximum Pole Spacing (Inches) 4"* Pole	5"* Pole	6"* Pole	Rod Spacing & Size Threaded 3' o.c.	Threaded 4' o.c.	Threaded 5' o.c.	Unthreaded 3' o.c.	Unthreaded 4' o.c.	Unthreaded 5' o.c.
12'	6½'	26"	48"	80"	5/8"	3/4"	3/4"	1/2"	5/8"	5/8"
14'	6½'	24"	42"	70"	5/8"	3/4"	7/8"	5/8"	5/8"	3/4"
16'	6½'	18"	32"	52"	3/4"	7/8"	1"	5/8"	3/4"	3/4"
18'	7'	-	24"	40"	7/8"	1"	1"	3/4"	3/4"	7/8"
20'	7'	-	18"	30"	7/8"	1"	1 1/8"	3/4"	7/8"	1"

* Min. top diameter; inches

Pole and tie-rod spacing are the same.

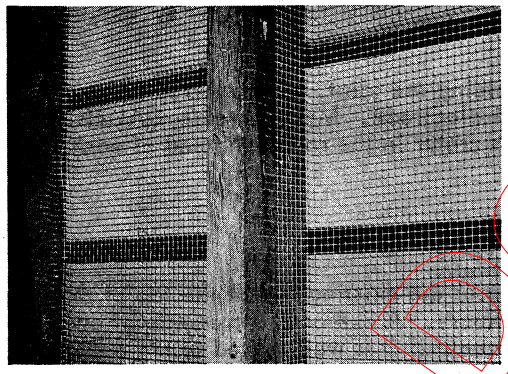
MAKING A CRIB GRAIN–TIGHT

The experience of several farmers and universities has shown that shelled corn can be stored in cribs that are not weather-tight from harvest to the middle of the following summer. If this is the way you will process your corn, you need only make the remodeled crib grain-tight.

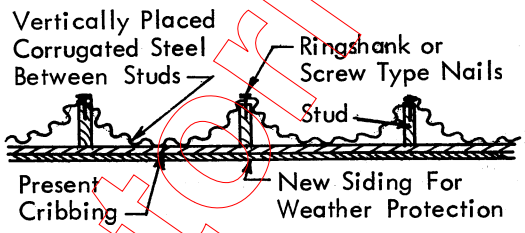
A crib designed or remodeled for this use will not work well for aeration after drying corn, or as a bin for drying wet corn. It will be difficult to fumigate the corn to control insects as the walls cannot be effectively covered with canvas or plastic.

Stud-Frame Cribs

One successful method that has been used is shown below. The best way to apply the one-quarter inch hardware cloth is to fit it between the studs, letting it rest against the inside face of the cribbing.

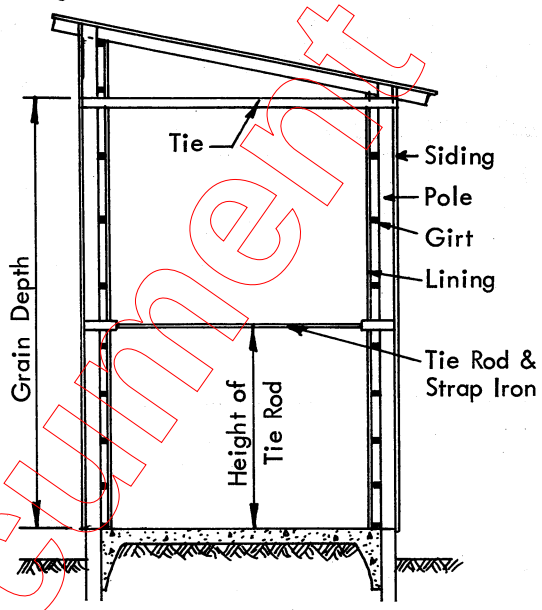


Another method of making the crib grain-tight is to place corrugated steel sheets between the studs. Fasten the sheets to the studs with ringshank or screw type nails.



Pole Cribs

The inside of the crib must be lined with material that will support the pressure of the corn. The most practical way to do this is to install girts between the poles to which a lining material is attached.



Recommended girt (support) spacings are listed in Table 6. Some materials do not have sufficient strength to span the recommended girt spacings in Table 6. The maximum spacing between supports for commonly used crib materials is listed in Table 7.

Table 6. Recommended girt spacing (inches)

Grain Depth (feet)	Pole Spacing (feet)	Girt Size: 2 x 4 (Rough; flat)	2 x 4 (Dressed; On Edge)	2 x 6 (Dressed; On Edge)
8-12	3	24"	32"	--
	4	14"	18"	--
	5	--	12"	28"
12-16	3	18"	26"	--
	4	12"	16"	30"
	5	--	--	24"
16-20	3	18"	24"	--
	4	12"	28"	--
	5	--	--	20"

Table 7. Maximum girt spacing permitted by strength of lining material (inches)

Grain depth (feet)	Type of Lining Material: $\frac{3}{8}$" plywood	$\frac{1}{2}$" plywood	$\frac{5}{8}$" plywood	$\frac{3}{4}$" plywood	1" boards	$1\frac{1}{4}$" Corrugated steel, 28 ga.	$2\frac{1}{2}$" Corrugated steel, 28 ga.
8-12	14	18	21	24	31	15	21
12-16	13	16	19	22	28	13	19
10-20	12	15	18	20	26	13	18

MAKING A CRIB WEATHER–TIGHT

If corn will be stored for a year or more, the crib should be made weather-tight to reduce spoilage. If the roof is in good condition and does not leak, it will not have to be altered. For most cribs, only the walls need to be altered.

A variety of methods may be used to make the crib walls weather-tight. Several are described below.

Stud-Frame Cribs

A method commonly used is to line the inside of the stud with exterior-grade plywood or matched boards of top quality. The minimum thickness of plywood is three-eights inch for 12-inch stud spacings, one-half inch for 18-inch spacing, and five-eights inch for 24-inch spacing.

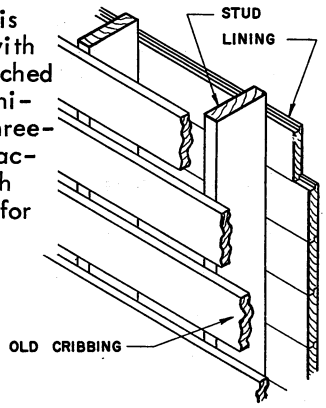
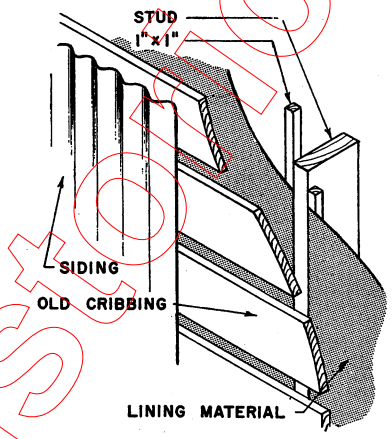


Table 8. Plywood thickness requirements--grain bin walls
(1" lumber satisfactory for crib walls)

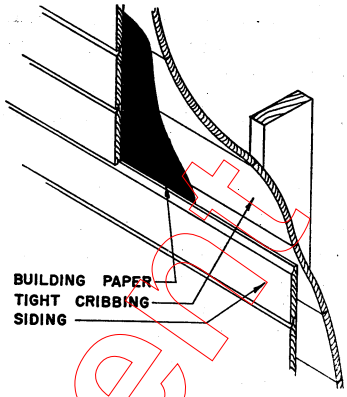
Stud Spacing	Depth of Fill (Shelled Corn) 8	12	16	20
12"	5/16"	5/16"	3/8"	1/2"
16"	3/8"	3/8"	1/2"	5/8"
20"	1/2"	1/2"	5/8"	3/4"
24"	5/8"	5/8"	3/4"	1"
32"	3/4"	1"		



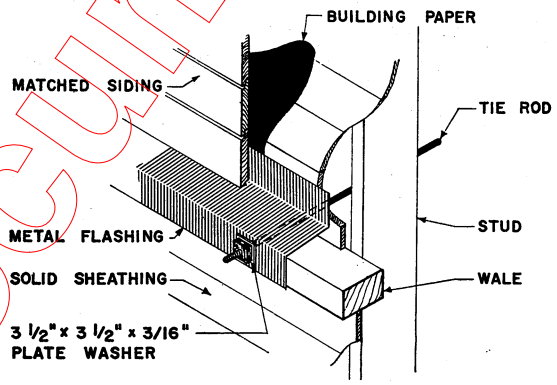
Another method of weatherproofing walls is to line the inside of the cribbing with sheet metal, moisture-resistant hardboard or other suitable material. Then cover the outside with a weather-resistant siding material.

Fit the lining between the studs. Cover any cracks with wooden strips. Fasten the cribbing to the studs with at least four eight penny screw-shank or ring shank nails per square foot of wall surface. Apply the siding following the manufacturer's recommendation.

Renailing cribbing and covering with siding is another method of making the walls weathertight. Cribbing that is in good condition can be removed and renailed so that no space is left between the boards. Cover the cribbing with building paper and complete the siding to form a good weathertight wall.

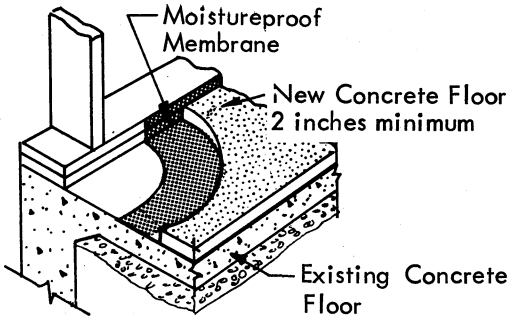


In making the walls weathertight, pay particular attention to construction adjacent to the wale. The wale should bear directly against the studs and have flashing installed as shown below.



The floor must be altered if there is any possibility that moisture will penetrate to spoil the corn. Wooden floors that are supported well above ground level will be adequately protected, but a concrete floor resting directly on the ground may need moisture proofing, especially if the crib is in a poor drainage area.

A concrete floor may be made moistureproof by applying a layer of 45-pound, smooth-surface, roll roofing, or six mil polyethylene, before covering the floor with at least two inches of concrete.



Pole Cribs

In addition to lining inside the girts, a weathertight siding may be applied outside the poles. A lining alone will normally not be weathertight. Siding protects the girts and lining from weather damage and decay. A material like metal siding sheets can be applied horizontally directly to the poles.